State of Connecticut
Department of Environmental Protection
Bureau of Water Protection & Land Reuse
Planning & Standards Division

Physical, Chemical & Biological Attributes of Streams vs. Amount of Upstream Impervious Land Cover

Reports

Physical, Chemical, and Biological Attributes of **Moderately Developed** Watersheds within Connecticut

Physical, Chemical, and Biological Attributes of **Least Disturbed** Watersheds within Connecticut

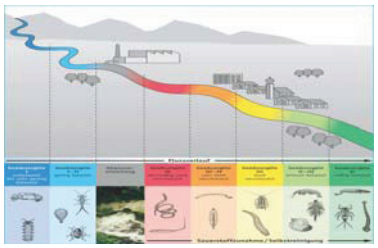
ADDENDUM-Least Disturbed **Site Characterization**

Impervious cover/Impervious surface 101: Impervious surface or impervious land cover (IC) is defined in a variety of ways. A simple definition is any land use alteration which causes water to flow over a surface instead of soaking into the ground. Several examples are paved areas, building roofs, parking garages, etc. The impact of IC on water quality is complex as both water quality and water quantity are affected. Water quality is affected by many different potential pollutants like hydrocarbons, metals, nutrients, bacteria, sediment, etc. As water flows across and over IC the water can "pick-up" these pollutants and carry them into the stream.

Compounding any effect from polluted runoff is how IC changes the natural water cycle. Under normal conditions precipitation soaks into the ground, enters the water table and finally into a stream. IC disrupts the normal cycle by preventing water from soaking into the ground. All of the water must flow across the surface to a storm drain and into a stream. The result is a very quick water-level rise and fall even a small amount of rain. Secondarily, since less water is entering the groundwater, the base flow within a stream is reduced. Both of these modifications to natural stream flow have, as one would expect, its own negative impact on water chemistry, biology, and physical habitat.

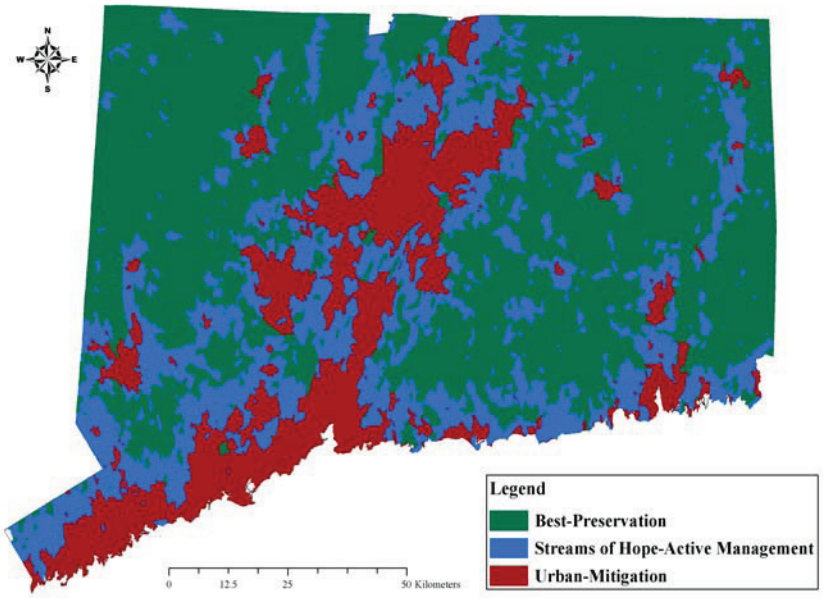
Background:

Many studies have evaluated the relationship between the water chemistry, fish and insects living in a stream and the amount of development upstream. Consensus is as land cover changes from forested (few people) to urban (many people) water chemistry and the organisms living in the stream shift from good conditions (a diverse community of pollution sensitive organisms) to poor conditions (dominated by a few types of pollution tolerant organisms). This gradient was first documented in 1909 by 2 German scientists, Kolkwitz and Marrson. They documented the community of organisms above and below a pollution source were much different.



Kolkwitz & Marrson were first to document changes in macroinvertebrate community structure above and below a change in landuse.

One hundred years later we can make similar conclusions right here in Connecticut. With data collected by satellite we are able to determine how much of the land is covered by different types of categories like agriculture, forest, open water, and developed (data provided by UConn CLEAR Project http://clear.uconn.edu/). Most importantly for us is the ability to calculate the amount of IC within a watershed.

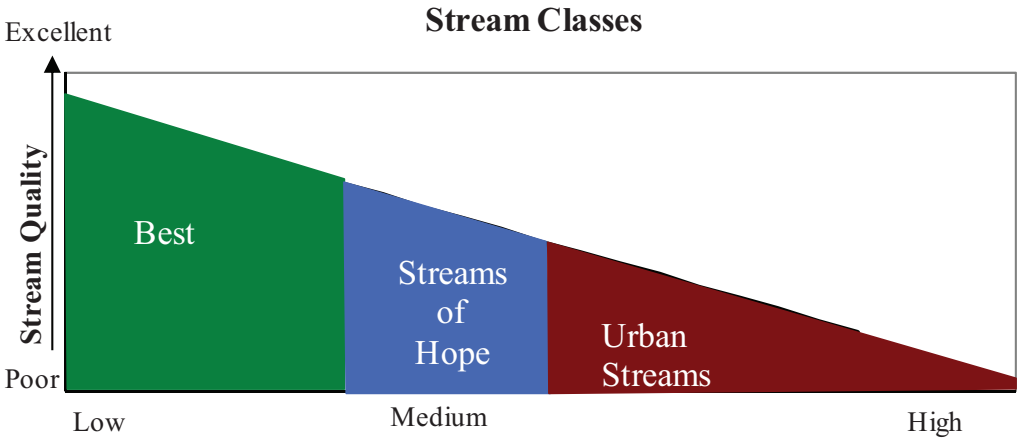


Connecticut's reality:

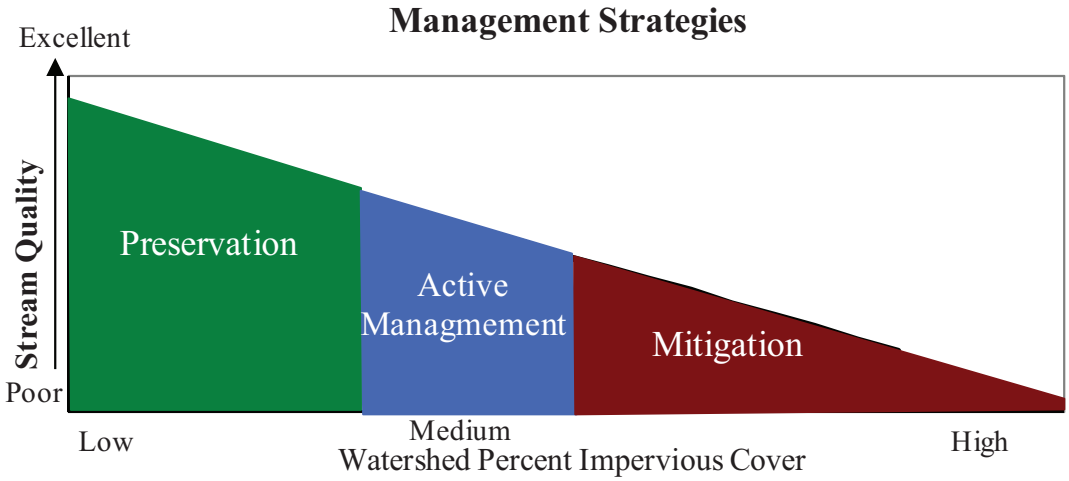
Recently, the Connecticut Department of Environmental Protection (CTDEP) has combined the satellite based land cover data with chemical and biological data from streams across the state. We discovered as did many other similar studies across the country that a relatively low percentage (12%) of impervious cover upstream of a point on a stream changes the stream dynamics so much that the

biological community no longer meets our State Water Quality Standards (http://www.ct.gov/dep/cwp/view.asp?a=2719&q=325618&depNav_GID=1654).

CTDEP's Total Maximum Daily Load (TMDL) program in cooperation with the Ambient Monitoring Program developed a conceptual model based on the biological community and the amount of IC upstream of the sampling point. The outcome is shown below. Streams with excellent water quality have the lowest amounts of IC. Those with poor water quality have the highest IC. In general as the amount of IC increases the quality of the stream will decrease.



With this general model, land use planners, water quality managers, and other resource stakeholders can develop a plan for any particular watershed. For example watersheds in the best category above would probably be prioritized for preservation. Those in the worst category prioritized for mitigation. Finally the most important class are those between the best and worst. Streams in this class are a mixture of meeting or not meeting water quality standards. Without active planning and the expectation of increasing IC, streams in this category could lose their potential to support an adequate biological community. Streams in this class should be actively managed to reduce the impact of IC as much as possible.



Supporting Data

In an attempt to model the multiple stressors associated with impervious cover the CTDEP has authored a TMDL for impervious cover (http://www.ct.gov/dep/cwp/view.asp?a=2719&q=325604&depNav_GID=1654). To support this work two studies have been completed. The first was designed to evaluate stream condition in a narrow range of IC straddling the 12% threshold line. Using satellite land cover data 30 locations characterized by having upstream IC values between 6% and 14% were selected. The report detailing our findings is available on the web at:

Physical, Chemical, and Biological Attributes of **Moderately Developed** Watersheds within Connecticut

Important findings of this study were:

A. The range of 6-12% is a battle zone. It is where active management will most likely insure good water quality. Without active management stream quality will continue to decrease into the lowest category.

B. With increasing development pressures within the State, the total number of streams with 6-12% IC will increase.

C. Several chemical parameters and biological attributes had negative responses across the 6-12% range. Meaning water quality decreased.

In a second study, the design was to document "natural" stream condition. Locations were selected to have less than 4% IC upstream of the location. This data set is an excellent summary of what present day stream conditions could be like with minimal human influence/disturbance. This report is available on the web at:

Physical, Chemical, and Biological Attributes of **Least Disturbed** Watersheds within Connecticut

Important findings of this study were:

A. Least disturbed stream segments are restricted to relatively small watersheds and are not disturbed evenly across the state.

B. All of the stream segments had diverse communities dominated by sensitive organisms.

C. Even with many variables controlled for, there was noticeable natural variability

D. These were not all of the "least disturbed" or "most natural" watersheds and those charged with managing natural resources should be aware they exist and those not yet identified should be sought out and inventoried.

E. Two of the 30 were very close to if not meeting "undisturbed" conditions.

We hope that these reports will be useful to aid and assist those charged with managing the natural resources at the local state and federal level so to best protect, preserve, maintain and or restore the integrity of our surface waters. For additional

information or discussion please contact one of the CTDEP Bureau of Water Protection and Land Reuse staff below.

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